

## TEACHING MATERIAL GUIDANCE

### 1) Title of the material

*Wang, A.; Zhang, A.; Chan, E.H.W.; Shi, W.; Zhou, X.; Liu, Z. A Review of Human Mobility Research Based on Big Data and Its Implication for Smart City Development. ISPRS Int. J. Geo-Inf. 2021, 10, 13. <https://doi.org/10.3390/ijgi10010013>.*

<https://www.mdpi.com/2220-9964/10/1/13>

### 2) Which section of the SUMP it is relevant to?

The authors presented a review of the literature and analyses related to human mobility research using big data and applying them to city management. Therefore, the article can be linked to the second, third and fourth sections of the SUMP circle related respectively to the determination of planning framework, analysis of the mobility situation (in particular the analysis of problems and opportunities for all modes of transport - **subsection 3.2.**), scenario building and joint evaluation (development of scenarios of possible futures - **subsection 4.1.**) and vision and strategy development (arguments for stakeholders – **subsection 5.1.**).

### 3) Which Mobility Manager knowledge this material is the most relevant to?

It is related to Transport and mobility planning (section 1 of the Mobility Manager competencies) especially 1b (employment of ITS/ICT and smart measures) and also to section 5 Data analysis for mobility planning especially 1a (data collection and analysis).

### 4) Problem approached and content overview

Problem approach – general understanding of the role of human mobility research using big data and applying them to city management. With the rise of big data and technological advances, comprehensive, data-driven knowledge of urban systems is becoming more and more achievable, but the link between big data research and its application, such as in smart city development, is not clearly articulated. Focusing on human mobility, one of the most studied applications of big data analytics, a framework for linking international academic research to city-level governance policies was developed and applied to the case of Hong Kong. The literature on human mobility research using big data was reviewed. This research contributes to the discovery of spatial-temporal phenomenon, the identification of differences in human behaviour or spatial attributes, the explanation of mobility dynamics, and the application to urban management. The application of the research to smart city development was then analysed based on email enquiries sent to various government departments in Hong Kong. The challenges identified include data isolation, data unavailability, the play between cost and data quality, limited knowledge from rich data, as well as alienation between the public and private sectors. With further improvements in the practical value of data analytics and the use of data from multiple sectors, pathways to achieving smart cities from a policy-making perspective are identified.



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Spatial-temporal characterization of human mobility, as the most studied application of big data analytics, can be used to facilitate smart city development, in many areas such as smart traffic, smart urban planning, smart health, smart security and safety, smart commerce, etc. For example, the convergence of transport and information technologies plays a key role in facilitating collaborative transport, where data streams from transport measurement, geographic information science and social media can be combined to engage people and make decisions together. Geospatial data analytics, whether in traditional raster, vector or graphical forms or from advanced sources in the form of sensors and mobile devices, is enhancing location capabilities, which has been applied to save fuel and time, increase revenue and healthcare.

With the development of big data and technological advances, urban development can be better understood and promoted based on data-driven knowledge. On the data analytics side, the practical value of data-driven research needs to be uncovered, while on the city development side, transitions to smarter applications across multiple fields and disciplines are constantly emerging. How governments and policymakers can apply data-driven research to smart city development is worth further exploration. To bridge these two sides of data and practice, this article, building on existing research on human mobility in the big data era, aims to explore the progress of research in this area and potentially how it can be applied to smart city development. A research framework was established to link data-driven human mobility research with the potential implementation of smart city developments. It mainly consists of two main parts, which are (1) a literature review of the international academic research on human mobility with big data, and (2) a policy review and analysis of smart city development at the city level. Based on the literature review, conclusions are drawn on the application of Big Data to smart city development.

### 5) Who could be interested in this material?

The article is aimed at students and those looking for a well-organised and concise introduction to the application of Big Data on human mobility in smart city development. The article contains many references to academic literature in the area of human mobility research using Big Data from various sources. The technologies and measurements described can be helpful for those developing measures within the SUMP framework.

### 6) What is worth mentioning as an innovative factor for the reader?

Big data offers the opportunity to gain a deeper understanding of human mobility attributes and human-space interaction. This paper explores how data-driven human mobility analysis can be used to promote the smart city. First, a systematic review of big data-based human mobility studies related to the smart city was conducted. The studies were analysed according to four levels of objectives: discovery of the phenomenon, identification of differences, explanation of differences, and implications for city management. It also reviewed how human mobility research has helped cities to combat the COVID-19 pandemic. Besides, based on email communication with government departments in Hong Kong, the application practices of big data in building a smarter city



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from a human mobility perspective and the main challenges in applying big data analytics for urban mobility were analysed. There are many opportunities to achieve a smarter city by improving the practical value of data analytics, even if there are still barriers. When developing or optimising analytics methods, researchers are encouraged to work with managers and decision-makers to integrate more types of data into analytics to transform absorbed big data into generalised knowledge and promote the applicability of technical methods and models in the operation of urban systems. By focusing on urban problems rather than the data itself, more practical analytics that incorporates knowledge or theory from multiple disciplines will make better use of data to serve people as well as facilitate the use of resources. In the meantime, researchers need to pay attention to various uncertainties that may affect the applicability of their research, such as the representativeness of the respondents, uncertainty and oscillations in mobility patterns extracted from the data, and the protection of personal data and privacy. The article also illustrates the relationship between data, research and policy application, identifying the role of researchers in computer science and geography, practitioners in the market or government, and policymakers in promoting smart applications. Despite its limited scope and urban context, this study brings some insights into data-driven research and smart city development.

### 7) Limitations

The research presented links big data research to smart city practice but is limited in terms of the scope of the research and the generality of the proposed framework. The literature review, although covering a wide range of applications, may not be sufficient to cover all the applicability of the research. As the focus of the study is on the application of research on the policy side rather than on the methodological side, deep evaluations for a particular type of data or method are not included. Research focusing on deeper analysis of data from a specific source, e.g. location-based applications, smart cards, etc. would help move forward to improve effectiveness in practice. The problems and barriers identified in this study can be applied to other cities where authorities play an important role in promoting smart city initiatives. However, the policy analysis is limited to the Hong Kong city context, where smart city development is government-oriented instead of being dominated by the private sector as in most Western countries, and the proposed framework/methodology in this study can be applied to other cities to analyse the barriers in different urban contexts.

